IPGRI

IPGRI in sub-Saharan Africa

SSA 1999–2000

Regional Report

The International Plant Genetic Resources Institute (IPGRI) is an international scientific organization, supported by the Consultative Group on International Agricultural Research (CGIAR). IPGRI's mandate is to advance the conservation and use of plant genetic resources for the benefit of present and future generations. IPGRI's headquarters are in Maccarese near Rome, Italy, with offices in another 22 countries worldwide. It operates through three programmes:

- the Plant Genetic Resources Programme
- the CGIAR Genetic Resources Support Programme
- the International Network for the Improvement of Banana and Plantain (INIBAP)

Cover illustration:
Collecting sorghum samples, Sangwe, Zimbabwe.

Citation:
IPGRI. 2001. Regional Report Sub-Saharan Africa 1999–2000. International Plant Genetic Resources Institute, Rome, Italy.

ISBN 92-9043-490-2

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About this report

This report highlights some particularly significant achievements of IPGRI's activities in sub-Saharan Africa in 1999–2000 and describes the impact that this work is having.

Past achievements of IPGRI in SSA are detailed in IPGRI's pre-1999 series of Annual Reports. Further information is available from IPGRI's Web site, http://www.ipgri.cgiar.org.

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Regional Report 1999–2000

Foreword

IPGRI's goal in sub-Saharan Africa is to advance the conservation and use of plant genetic resources in support of human development. IPGRI pursues this goal by supporting national plant genetic resources programmes, strengthening regional and international collaboration, and developing human resources and capacities. IPGRI's sub-Saharan Africa programme also supports work on policy, information and public awareness of plant genetic resources, and activities to increase our understanding of the diversity of genepools in the region.

IPGRI's activities in sub-Saharan Africa assist the poorest and most vulnerable groups in the region to access and use plant genetic resources. The institute promotes the use of genetic resources in genebanks in order to maximize their potential to contribute to breeding programmes and agricultural productivity both in Africa and beyond.

IPGRI places a special focus on crops that are grown and consumed by poor and marginalized farmers, especially women, yet are neglected by research. These crops include leafy vegetables, tuber crops, neglected grain legumes, small grains, cucurbits and forestry species. Research on micronutrient-rich leafy vegetables particularly benefits women and children, because they tend to suffer most from iron and vitamin A deficiencies.

In sub-Saharan Africa, as elsewhere, IPGRI works with and through its partners. Chief partners in the region are national agricultural research systems, including national agricultural research organizations, universities and NGOs, and regional and subregional networks on plant genetic resources. Traditionally, the focus of genetic resources activities in the region has been on supplying appropriate material to breeders but, more and more, institutions are working directly with farmers to sustain community-level processes such as seed diversity fairs, farmer field fora and community genebanks. IPGRI SSA is increasingly involved in supporting these processes.

The past two years have been challenging for the IPGRI SSA group. During this period, we lost three prominent scientists, colleagues and friends. Professor James Chweya, IPGRI Honorary Research Fellow, a pioneer in our work in African leafy vegetables, died early in 1999. Dr Abdou-Salam Ouedraogo, Regional Director for IPGRI SSA, was tragically killed in a plane crash in the early days of the year 2000. Mr Eric Quarcoo, a scientist in the West Africa subregional programme in Benin, battled with cancer through most of 2000, finally succumbing to the disease. These three deaths, all occurring within such a short time, were a major blow to the institute. We grieve for the loss of our colleagues, but we are also inspired and challenged by the great contributions that they made to IPGRI's work in the region. We therefore dedicate this report to the memory of our three departed friends.

We look to the future with enthusiasm and anticipation of the challenges that lie ahead as countries in the region increase their commitment to genetic resources conservation and use. At the same time, issues of ownership, access and benefit sharing relating to genetic resources are receiving significant attention in major global and international conventions and negotiations, such as the Convention on Biological Diversity and the FAO International Undertaking, as well as in national policy discussions throughout Africa. IPGRI SSA aims to increase its work on plant genetic resources policy, and to provide increased support and guidance to national programmes in this critical area.

This report provides a broad overview of our programmes and achievements over the past two years. We are grateful to the donors who have supported our work with partners in the region. We look forward to further support as we continue to use the potential of genetic resources to enhance food security for present and future generations.

Kwesi Atta-Krah
Regional Director

Geoffrey Hawtin
Director General

The sub-Saharan region

The sub-Saharan Africa (SSA) region comprises 48 sovereign states. These are grouped into five subregions, namely eastern Africa, southern Africa, western Africa, central Africa and the islands off the eastern coast of the continent (i.e. Madagascar, Mauritius, the Comoros and the Seychelles). Africa's topography is characterized by the Atlas mountains in the north, the Cape ranges in the south, and a series of basins and plateaux in between, divided in the east by the Rift Valley and its associated highlands. These include Mount Kilimanjaro, the highest point in the continent. Africa is home to the world's largest desert, the Sahara, which stretches from the Atlantic Ocean to the Red Sea. As a result of this diversity of topography and climate, SSA has a wide range of vegetation types, ranging from deserts and alpine shrub land to mangrove swamps and tropical rainforests, with all possible intermediate types.

Well over 600 million people live in Africa south of Sahara. The vast majority of these people depend directly on the land for their sustenance. In the rainforests of central Africa and in the dry lands of the Kalahari, communities live by hunting and gathering fruits, nuts, tubers and leaves. Elsewhere, in more favourable environments, a vast array of agricultural systems has evolved, ranging from nomadic and transhumant livestock production through to intensive smallholder mixed crop–livestock systems. Wood accounts for almost 95% of the fuel used in rural areas throughout the continent.

Overall, only about 6% of Africa's land is cultivated. Even so, the agricultural sector is the largest source of employment and provides a high percentage of export and foreign currency earnings. Although commercial agriculture is important in some areas, agriculture is predominantly small-scale subsistence or near subsistence farming, much of it based on shifting cultivation. In the past, agricultural development has aimed at replacing traditional practices with farming systems based on exotic cash and food crops with chemical inputs, large-scale irrigation and mechanization. More and more, however, it is being recognized that indigenous African farming systems, practices, crops and varieties are finely tuned to prevailing ecological conditions and must largely form the basis of sustainable agricultural development. SSA subsistence farmers are mainly women, who produce more than 75% of the household food through field cropping and home gardening.

The greatest species diversity occurs in equatorial areas because species diversity tends to be highly correlated with annual rainfall. Endemism, which is the proportion of species

Biodiversity in SSA

The countries with the largest numbers of plant species in the continent are:

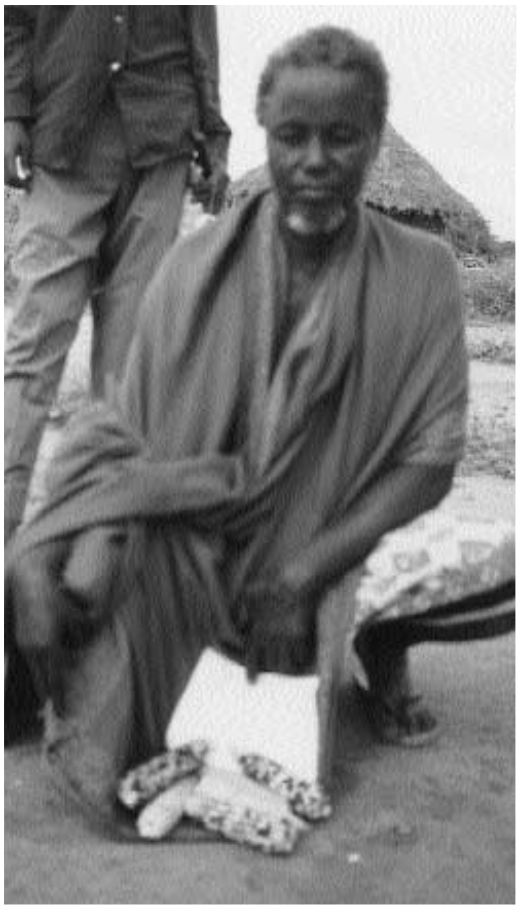
Country	No. of species
South Africa	22 000
DR Congo	13 000
Tanzania	13 000
Madagascar	12 000
Cameroon	10 000
Kenya	9000
Gabon	8000
Ethiopia	7000
Uganda	7000
Angola	6000
Zambia	6000
Nigeria	6000

not found anywhere else in the world, is high in the region. Madagascar, for example, is very rich in the number of endemic species, as are other islands, such as Mauritius and São Tomé and Principe. On the mainland, areas rich in endemic species include lowland rainforests (e.g. in Côte d'Ivoire, Liberia, Nigeria, Cameroon and Gabon), montane forests (mainly in eastern Democratic Republic of Congo, western Uganda and Rwanda) and coastal areas (particularly in Kenya and Tanzania). In the arid areas, major centres of endemism include Somalia, Ethiopia and Namibia.

SSA has given the world some of its most important crops. Those that contribute significantly to subsistence requirements, at least locally, include five cereals, four legumes, three cucurbits, five oil seeds, twelve vegetables, four roots and tubers, and five to ten fruits. Among these crops are sorghum, millets (finger, pearl), teff, fonio, bambara groundnut, cowpea, cat's whiskers (*Cleome gynandra)*, water melon, melon, gourds, sesame, African oil palm, noug, yam, Hausa potato and cocoyam. Introduced crops such as maize, banana, rice, cassava, beans and cacao also contribute significantly to African agriculture, and some have developed secondary centres of diversity in the continent. In addition to the widespread staple crops, there are many species that are very important in relatively restricted geographic areas. Among these are teff, fonio, bambara groundnut and some other minor millets as well as vegetables, fruit trees and medicinal plants.

The world's major regions of crop diversity include the Ethiopian highlands, the Sahelian transition zone, with the delta of the Niger river, and the humid forest zone of West and central Africa. The highlands of Ethiopia are a centre of origin for coffee, and a centre of diversity for sorghum, lentil, wheat and barley. Tropical West Africa is a centre of origin and diversity for African rice (*Oryza glaberrima*), oil palm, yam and cowpea.

There is considerable inter- and intraspecific diversity of crops, herbaceous and forestry species. A number of species endemic to the subregion include millet (*Pennisetum* spp.), sorghum (*Sorghum* spp.), cowpea (*Vigna unguiculata*), bambara groundnut (*V. subterranea*), African rice (*O. glaberrima*), fonio (*Digitaria exilis*) and yam (*Dioscorea* spp.), among others. Such endemic species have specific genetic constitutions that confer resistance to diseases and pests, the ability to produce in marginal soils, and resistance to some environmental hazards such as drought. These species are also preferred by the population for their culinary and organoleptic qualities and they hold a key to food security and sustainable development in the subregion. The genetic base of these crops is, however, being seriously eroded, largely as a result of their replacement in the farming systems, climate change, socio-economic factors, natural disasters and armed conflict.



Farmer showing diversity of maize in Somalia.
D. Kiambi

IPGRI in SSA

Awareness of the importance of conserving and using plant genetic resources increased substantially among scientific and policy-level leaders in SSA during the 1990s following the United Nations Conference on Environment and Development, the Convention on Biological Diversity and the 4th International Technical Conference on Plant Genetic Resources. This increased awareness has led to renewed commitment to the conservation of biodiversity. Over 40 countries in SSA submitted reports on the status of conservation and use of their plant genetic resources in preparation for the technical conference. IPGRI collaborated closely with the national programmes to compile the component subregional synthesis reports, which gave the SSA group a clear understanding of the national, subregional and regional priorities in conservation and use. These reports were used to develop a plan of action for IPGRI in the conservation and use of genetic resources in Africa that reflects the elements of the Global Plan of Action (GPA).

National programmes on plant genetic resources are considered to be the main elements in a global effort. In SSA, many national programmes in plant genetic resources are generally weak, so IPGRI devotes considerable resources to working with partners in the region to:

- facilitate national coordination of plant genetic resources
- develop regional networks on plant genetic resources
- sponsor thematic research and methodology development
- assist in plant genetic resources training and education
- provide information and documentation

IPGRI operates in the region entirely through partnership. Partners include national plant genetic resources institutions, international, governmental and non-governmental organizations, and scientific and developmental institutions. IPGRI's success in SSA is very much a result of this mode of operation.

IPGRI's INIBAP programme focuses specifically on banana and plantain with the aim of increasing the production from smallholder crops. This it does through collaborative projects and by coordinating and participating in the activities of the two regional networks concerned with banana and plantain.

This report provides an overview of the progress made by IPGRI and partners in the SSA region for the period 1999–2000. The specific institutions and organizations with which IPGRI collaborates are mentioned in the sections on respective activities.

Farmer in field planted with sorghum in Somalia. ***D. Kiambi***

IPGRI's strategy in SSA focuses on assisting the countries to develop nationally coordinated programmes that ensure cost-effectiveness, resource sharing and efficient operation. Approaches include organizing national workshops, developing national coordination committees, arranging policy level meetings, and providing relevant educational material, training and essential conservation facilities.

National coordination mechanisms

As a first step in developing coordinated mechanisms, national workshops are organized to bring key players together to review the status of activities, identify opportunities and constraints, and also to develop elements for national plans and strategies. In these workshops, institutional roles and responsibilities are identified and agreed. The workshops also serve to identify the focal points for activity implementation and to establish and agree on the constitution of national coordination committees or other mechanisms.

Since 1998, IPGRI has assisted more than 12 countries to organize national workshops, leading to better national coordination structures and staff deployment. For example, workshops in Benin and Togo resulted in the employment of new permanent staff to build up genetic resources activities. In The Gambia, a national programme was established under the auspices of NARI and a national committee was immediately established as part of recommendations made during the national workshop. National plant genetic resources committees normally serve the primary functions of coordinating national efforts, rationalizing strategies and plans, as well as serving as fora for discussions on national issues. The committees include a wide range of stakeholders such as NGOs and research and training institutions.

In the past three years, IPGRI has assisted in establishing committees in several countries including Benin, the Central African Republic, Côte d'Ivoire, Chad, The Gambia, Kenya, Nigeria and Uganda. Assistance has also been provided to Eritrea and Djibouti in developing national strategies and plans for agrobiodiversity, in collaboration with the World Conservation Union (IUCN). In another approach, IPGRI collaborated with DSE and GTZ, with funding from ZEL, to organize two international seminars in Germany. The first was held in June 1999 for 22 national programme leaders from 14 sub-Saharan countries to determine minimum conditions for a functional national programme. The second seminar was held in May 2000 and focused on West and central African countries. The main impact of the meetings was coherent policy planning and the coordination of genetic resources work at national, regional and international levels.

Physical infrastructure, facilities and equipment

The sustainable conservation of plant genetic resources depends to a large extent on the availability of facilities and equipment for long- and medium-term conservation of germplasm *ex situ*. In the past three years IPGRI has endeavoured to assist the national programmes to procure the minimal essential facilities for germplasm conservation by developing joint project proposals with partners and mobilizing resources from more developed programmes. For example, through an AfDB funded project, IPGRI and the national programmes of several countries in West and central Africa, including Benin, Togo, Senegal and Côte d'Ivoire, have acquired basic conservation facilities. Similarly, through an IPGRI initiative the lusophone African countries have been able to procure conservation facilities through funding from the governments of Portugal and Brazil.

Research and training

An integral part of helping national programmes to develop is cultivating the abilities of staff to carry out research and training. In recent years, IPGRI's approach has been to organize in-country training courses, regional courses and individual skills training through secondment of staff to more advanced national programmes and training courses in local universities. Research capacity in national programmes has been increased by joint research projects with more advanced national programmes. For example, seed sun-drying experiments have been undertaken in collaboration with the National Gene Bank of Kenya with very good results, while research on targeted germplasm collections has been undertaken in collaboration with the Tanzania national programme and the Biodiversity Conservation and Research Institute, Ethiopia. With funding from UNEP, IPGRI in collaboration with the national programmes in Ghana, Malawi and Uganda successfully developed and implemented a research project on monitoring genetic erosion. An important component of the project was training of national programme staff in the research methodology, data collection and analysis.

Developing genetic resources policy

IPGRI staff in collaboration with national programme staff have organized policy meetings, consultations and workshops at high political levels to discuss plant genetic resources issues with policy makers. Such meetings are difficult to arrange but are normally very effective. In Uganda, for example, IPGRI regional scientists in collaboration with NARO organized a policy level meeting in July 1997 in which two cabinet ministers participated. The recommendations of the workshop led to the establishment of a national committee and a national programme under the auspices of NARO. Since its inception in 1998, the programme has grown to four personnel and enjoys a budgetary allocation through NARO, its host institution. Similar policy workshops have been organized in Kenya and Nigeria, with positive results.

To understand the status of genetic resources policy in the region, IPGRI collaborated with ACTS on a survey of existing policy, legislative and institutional measures. The survey revealed major weaknesses in *ex situ* conservation policies and legal frameworks and recommended integrating genetic resources policy into all relevant sectors, while at the same time providing guidelines for access to plant genetic resources by others and the sharing of benefits. IPGRI also collaborated with ACTS to organize a roundtable discussion with high-level policy-makers in East and Southern Africa in December 1999. The meeting discussed emerging national and international policy issues on plant genetic resources and food security, having an immediate impact in helping establish biodiversity as an element in many countries' policy considerations.

IPGRI has worked to develop a highly efficient networking approach to genetic resources since its early days. Networks link members with common interests, allowing them to share resources, information and technologies. Many countries in SSA have realized that this is an effective way to conserve plant genetic resources. IPGRI's networking in SSA is based on several formal structures, the largest of which deal with West and central Africa, southern Africa and East Africa.

The SSA Forest Genetic Resources Programme

Important forest genetic resources are threatened in SSA by the high demand for wood and non-timber forest products such as medicines. In recognition of this fact, the SSA countries requested IPGRI to facilitate the development of a collaborative programme on forest genetic resources in the Third Regional Workshop of the Heads of Forest Seed Centres and Programmes held in Dakar in 1997. Further consultations led to the establishment of SAFORGEN in 1998. The objectives of SAFORGEN are:

- to strengthen institutional frameworks and national programmes for forest genetic resources
- to intensify cooperation among countries for forest genetic resources conservation and use
- to develop methodologies and tools for the conservation and sustainable use of forest genetic resources

So far, member countries have proposed four pilot SAFORGEN sub-networks (Food Tree Species, Wood and Fibre Species, Medicinal Tree Species and Fodder Tree Species). Countries set network priorities (species and activities), define national and collaborative activities and disseminate results of these activities to all network members. Studies sponsored by UNEP and IPGRI are being conducted at field level on the genetic diversity and the impact of human practices on two fodder tree species in Benin, two food tree species in Kenya and two medicinal tree species in Togo. The Regional Secretariat of SAFORGEN, which is managed by IPGRI, provides logistic support to the sub-networks and plays the role of facilitator and secretariat during network meetings. Regional training workshops on conservation and sustainable utilization of forest genetic resources were organized in March 1998 in Ouagadougou, Burkina Faso for French-speaking countries, and in December 1999 in Nairobi, Kenya for English-speaking countries.

Eastern Africa Plant Genetic Resources Network

The subregional synthesis report on East Africa, which was prepared for the GPA, identified many opportunities for regional collaboration. EAPGREN was established in November 1997, under the umbrella of ASARECA. IPGRI and a number of national plant genetic resources programmes have been working effectively towards the creation of such a network. Member states are Burundi, the Democratic Republic of Congo, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan and Uganda. It is funded by Sida with IPGRI and Nordic Gene Bank scientific input. EAPGREN's mission is to harness, conserve and promote greater use of plant genetic resources for food security, improved health and socioeconomic advancement of the rural communities. In June 2000 Sida approved funding for start-up of network activities. Following this development, the network held its

Networks in plant genetic resources

first Regional Steering Committee meeting in Entebbe, Uganda from 5 to 7 October 2000. In its first meeting the Committee developed workplans for 2001 and a programme of work for four years. Among the regional priority activities identified was the need for development of an information and documentation system that would enable harmonization and ease of exchange of plant genetic resources data and general information. The network's activities will start in 2001.

Genetic Resources Network for West and central Africa

Few national plant genetic resources programmes exist in western and central Africa. Major constraints to developing activities in the subregions are lack of awareness and appreciation of the importance of conservation and use of plant genetic resources. At the regional workshop on implementation of the GPA jointly organized by FAO, IPGRI and CORAF in Cotonou, Benin in February 1998, the West and central African national programmes reached a consensus to establish GRENEWECA under the auspices of CORAF/WECARD. The main objective of the network is to conserve plant genetic resources through a coordinated network of functional national programmes with well-articulated research priorities, action plans and national strategies. The network is governed by a general assembly of all member countries and partners from regional and international organizations. It has a steering committee of 11 elected members and a secretariat based at IPGRI's SSA Cotonou Office. With financial support from the AfDB, the network has started a broad range of activities, offering training programmes for national plant genetic resources scientists and promoting regional projects on plant genetic resources exploration, collection and evaluation, as well as conservation techniques.

SADC Regional Plant Genetic Resources Network

Following a consultation organized by SACCAR and IBPGR (now IPGRI) a subregional plant genetic resources programme known as SPGRC was established in 1988, within the framework of SACCAR. IPGRI and NGB provide technical assistance to the project. To date 14 countries are members of the SPGRC: Angola, Botswana, the Democratic Republic of Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, the Seychelles, Swaziland, Tanzania, Zambia and Zimbabwe. The project has established a regional genebank, with the base collection housed at SPGRC in Lusaka, Zambia and national plant genetic resources centres in each member state, each holding their respective active collection. Various activities have been undertaken, such as collection, conservation, multiplication, characterization, evaluation, documentation and utilization of germplasm. During the past 12 years, SPGRC has been training many people in the SADC region to MSc level and providing short courses. Such training has mostly been carried out at the University of Birmingham, UK and the NGB in Sweden. Some regional thematic training courses have been organized in collaboration with IPGRI scientists. Through the network, crop working groups have been established. These include cereals and legumes, *in situ* and underutilized plants, forage and fodder, vegetables, vegetatively propagated plants, fruits and nuts, and oil seeds and industrial crops. IPGRI and NGB have assisted the work of these crop working groups by providing technical inputs at the groups' meetings.

The Banana and Plantain Research Network for East and Southern Africa (BARNESA)

BARNESA was formed in October 1994 by a consortium of national, regional and international research organizations with an interest in banana research in the region. The network comprises 12 NARS: Burundi, the Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Republic of South Africa, Rwanda, Sudan, Tanzania and Uganda. In addition, the international and regional centers, INIBAP/IPGRI, IITA, ICIPE and the Institut de Recherches Agronomique et Zootechnique, Burundi are *ex officio* members of the network. Coordination is provided by the INIBAP office in Kampala, Uganda.

BARNESA has developed a five-year strategic plan, the implementation of which has resulted in a higher profile and funding for *Musa* research in the subregion. NARS scientists are benefiting from increased contacts between each other and from capacity building activities. For example INIBAP, IITA, ICIPE and NARS have been involved in the joint organization of training courses and workshops on bananas. New and improved *Musa* germplasm is being introduced and evaluated in East and southern Africa, and existing *Musa* diversity is being documented with the aim of effecting its conservation with the aid of members of the network.

West and central Africa regional research network on banana and plantain

*MUSA*CO was created in 1997 under the auspices of WECARD/CORAF. It has 12 country members (Benin, Cameroon, the Central African Republic, The Congo, Côte d'Ivoire, the Democratic Republic of Congo, Gabon, Ghana, Guinea, Nigeria, Sierra Leone and Senegal) and three institutional (IITA, CRBP and INIBAP) members. The goal of *MUSA*CO is to contribute to sustainable production of, and productivity in, banana and plantain in West and central Africa for increased income and food security. *MUSA*CO attempts to achieve this goal through research, information exchange, capacity building and technology transfer. The network is governed by a steering committee that develops annual and medium-term work plans according to the regional priorities. The INIBAP programme of IPGRI coordinates *MUSA*CO from its regional office for West and central Africa in Douala, Cameroon. Recommendations have been made that fact sheets be prepared on technologies available in the subregion and that germplasm collecting be carried out in the Congo basin and elsewhere in order to characterize and conserve the complete diversity of *Musa* in West and central Africa. Baseline information on research activities and banana production is being collected to contribute to a regional research strategy. *MUSA*CO members are also participating in projects to enhance peri-urban agriculture and evaluate improved varieties.

Thematic research and methodology development

thematic research and methodology development

Research is essential to understanding plant genetic resources. To develop appropriate strategies and technologies for conservation, IPGRI works with national partners in a variety of research areas.

Genetic erosion and indigenous knowledge

Effective conservation, both *in situ* and *ex situ*, requires a clear understanding of the extent and distribution of genetic diversity and how it is changing over time. Genetic erosion occurs when genetic diversity in populations is lost, for example when whole habitats are destroyed (through deforestation), farmers' varieties are lost (through disease or war) or specific crops are no longer grown (through introduction of high-yielding varieties). In the recent past, IPGRI has conducted research activities that aimed to monitor genetic erosion, estimate past losses and assess the risk of future loss of diversity. In particular, research has focused on the best methods of monitoring genetic erosion in crops and wild species.

Bambara groundnut in Ghana

In collaboration with two country institutes and farmers, a study was carried out in the upper west region of Ghana to monitor genetic erosion and gather indigenous knowledge on bambara groundnut. The research revealed that bambara groundnut was considered a woman's crop and almost 60% of the farmers sold their produce. Although over 70% of the farmers stored planting seed in ash in pots, they bought almost 60% of the seed they used in planting in any one season from the local markets. This meant that the farmers could easily change the composition of the crop they were planting, made up of six or seven varieties. The farmers had a very clear understanding of why varieties were disappearing. The reasons for the losses included taste preferences, harvesting difficulties and late maturity. Other varieties were very sensitive to day length, so any changes in the seasonal cycle would disrupt the growth cycle and lower the yield. These were simple, pragmatic reasons that were very important to the farmers.

Case studies in Kenya

IPGRI in collaboration with the National Gene Bank of Kenya organized two genetic erosion case studies in Kenya using finger millet and rice. The studies aimed at determining the status and extent of genetic diversity, identifying the causes of genetic erosion and documenting the extent of the indigenous knowledge in the farming communities. The rice case study was carried out in the Tana River delta, located in the semi-arid coastal zone of Kenya. A representative random sample of 70 respondents from 14 different villages showed the broad range of rice landraces grown in the area and the wealth of indigenous knowledge still available. Twenty-two different types of rice landrace were reported as being grown, while 30 had become extinct due to a multiplicity of factors that included an erratic flooding regime caused by drought, introduction of high-yielding varieties through government-aided projects and limited availability of seeds of landraces. The farmers in the region are, in general, willing to participate in future programmes for re-introduction and conservation of rice landraces.

Finger millet is an important subsistence cereal food crop in Kenya and the genetic erosion studies were carried out in semi-arid western Kenya, the Lake Victoria basin and parts of Central and Rift Valley provinces. Surveys carried out in 73 locations and based on responses from 88 farmers in 11 regions revealed that over 135 different farmers' varieties

were still being cultivated in the survey areas and farmers still retained a lot of indigenous knowledge. Proxy indicators of genetic erosion revealed that the threat to the genetic diversity of finger millet in Kenya is primarily the introduction and promotion of early maturing, faster growing and higher yielding crops such as maize. From the survey, it is evident that cultivation of finger millet landraces is on the decline due to poor yields, which do not provide enough food or income for rural households. This was compounded by the lack of a large market, insufficient supply of seeds and changing consumer preferences. Improving both the qualitative and quantitative traits in finger millet to enhance the market value of the crop could be a key strategy towards increasing cultivation of this crop and hence conservation of its genetic diversity.

Ex situ conservation technologies

Seed banking, one of the most commonly used methods for *ex situ* conservation of plant genetic resources, accounts for 90% of the 6 million accessions conserved *ex situ* globally. Seeds are dried to low moisture content and stored at subzero temperatures in cold stores or deep freezers. This technique is only possible for species with seeds that can tolerate desiccation and low temperatures. Species with seeds that cannot survive under such conditions are called recalcitrant. These species, and vegetatively propagated crops, are mostly conserved in field genebanks and as *in vitro* collections. In SSA only a few countries are able to construct and run expensive seed banks with refrigeration systems, because of the unreliable supply and high cost of electricity. IPGRI has been promoting research to develop alternative approaches for the conservation of plant genetic resources such as ultradry storage and cryopreservation. The ultradry storage technique has been tested and offers a promising low cost alternative that is practical and helps meet the conservation objectives of national partners.

Work has also focused on using natural energy sources to dry seeds for conservation. IPGRI has been working with the National Gene Bank of Kenya to investigate the effects of sun and shade drying on seed quality of *Zea mays* (maize), *Eleusine coracana* (finger millet) and *Arachis hypogea* (groundnut) (see Sun drying seeds, next page). Similar experiments are being carried out with partners at the Institut National de la Recherche Agricole du Bènin on grain legumes (*Vigna unguiculata* and *V. subterranea*) and maize, and at the Plant Genetic Resources Unit, Agricultural Research Corporation of Sudan on sorghum (*Sorghum bicolor*). In the latter two cases ultradry technology is being applied to real case situations to test the applicability of this technology on a large scale.

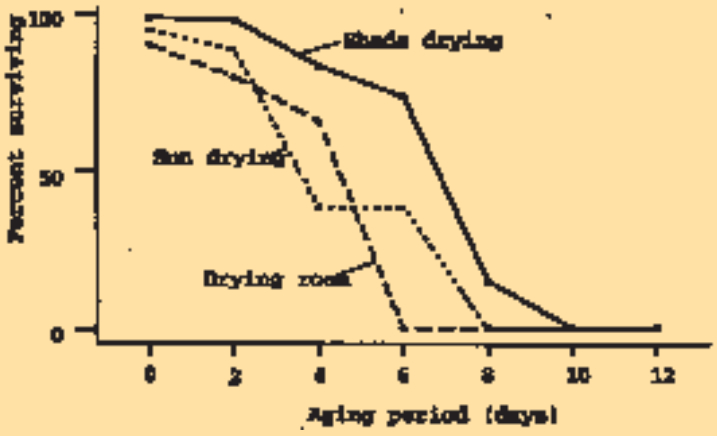
Cryopreservation tank at South Africa National Genebank. ***S. Moephuli***

Another technique that is gaining much attention is cryopreservation. Cryopreserving materials is a well-tested alternative to conventional low temperature storage that had not yet been applied to roots and tubers in the region. For example, in West Africa, GRENEWECA is carrying out experiments, with the University of Ghana, to determine the best way to dehydrate and freeze roots and tubers for their conservation.

Recalcitrant tropical forest tree seeds

Many tropical forest trees have recalcitrant seeds that make them difficult to handle and impedes their use. IPGRI, as part of a global project in collaboration with DFSC is undertaking a project on effective conservation and use of recalcitrant and intermediate tropical forest tree seeds with SSA partners including KEFRI, CNSF, NTSP, the Institut Senegalais de Recherche Agronomic of Senegal, the Forestry Research Institute of Malawi and the Forestry Commission in Zimbabwe. Participating institutes are developing and implementing optimal seed handling and storage methods for seeds with expected recalcitrant/intermediate behaviour. A screening protocol for desiccation tolerance has been developed and is being used to test more than 40 species of tropical forest species, including, from the SSA region: *Cordyla pinnata*, *Dovyalis caffra*, *Fagara xanthoxyloides*, *Kigelia africana*, *Lophira lanceolata*, *Melia azedarach*, *Pentadesma butyracea*, *Strychnos cocculoides*, *Syzygium cuminii*, *S. guineense*, *Vitellaria paradoxa*, *Warbugia salustris* and *Ximenia americana*. A project newsletter was produced and can be accessed at the DFSC website (www.dfsc.dk)

Sun drying seeds



Survival curve of postmature seeds of *Eleusine coracana* during ageing experiment.

Sun and shade drying of seeds of *Eleusine coracana* harvested at three maturity stages were compared with conventional drying in the controlled environment of a drying room maintained at 15ºC and 15% relative humidity. After drying the seeds were rehydrated over a saturated solution of magnesium nitrate, and an ageing exercise was carried out by exposing seeds to 50°C to study the effect of the drying regimes on seed quality. The preliminary results indicate that shade drying can be a useful method that gives better results than conventional drying. Additionally, post-mature seeds of finger millet were shown to have better survival rates than immature and mature seeds.

In situ conservation on-farm

In situ conservation on-farm is the continuous cultivation and management by farmers of a diverse set of populations of a crop in the environment where this crop has evolved. It includes immediately useful species (such as cultivated crops, forage and agro-forestry species), as well as their wild and weedy relatives that may be growing in nearby areas. On-farm conservation is an important complement to *ex situ* conservation. The *in situ* approach allows for conservation of diversity at ecosystem, species and genetic (intra-species) levels and ensures that the ongoing processes of evolution and adaptation of crops to their environments are maintained, a benefit that is central to *in situ* conservation.

IPGRI's broad objective in its work on *in situ* conservation of useful plants on-farm in SSA is to ensure that the approach can effectively contribute to the overall conservation and use of plant genetic resources. The farming systems where farmers' varieties are maintained are dynamic and inherently complex, and a major challenge for *in situ*

conservation is the development of the knowledge needed to understand the system, and determine where, when and how *in situ* conservation of agrobiodiversity on-farm may be effective. IPGRI helps national programmes to acquire the necessary capacity to sustain *in situ* conservation on-farm. It also supports the scientific research, training, planning and implementation of *in situ* conservation activities. With IPGRI's assistance, national programmes around the world, including some in SSA, have formulated a number of research projects designed to build up the scientific and information base on *in situ* conservation of agrobiodiversity (on-farm). These include:

- Strengthening the Scientific Basis of *In Situ* Conservation of Agricultural Biodiversity (Burkina Faso, Ethiopia, Hungary, Mexico, Morocco, Nepal, Peru, Turkey and Vietnam)
- Development of Strategies for *In Situ* Conservation and Utilization of Plant Genetic Resources in Desert Prone Areas of Africa (Mali and Zimbabwe)
- Farmers' Practice of Domestication and their Contribution to Improvement of Yam in West Africa (Benin and Nigeria)
- Home Gardens Project (Cuba, Ghana, Guatemala, Venezuela and Vietnam)
- *In Situ* Conservation of Banana (Uganda and Tanzania)

All of the projects are characterized by collaboration among different institutions within countries that have previously not worked together, collaboration among workers from different disciplines and collaboration among conservationists and local communities.

Work on these projects in SSA started only recently.

In situ conservation on-farm in Burkina Faso

In 1998, memoranda of understanding were signed between partners in the IPGRI coordinated project 'Strengthening the Scientific Basis of *In Situ* Conservation of Agricultural Biodiversity on Farm'. Five partners are working formally together on the *in situ* project, the Institut de l'Environnement et de Recherches Agricoles, the Université de Ouagadougou, the Université Polytechnique de Bobo-Dioulasso, the Fédération Nationale de Groupements Naam and the Ministère de l'Agriculture. All research activities in the project are being conducted under the umbrella of the Centre Nationale de la Recherche Scientifique et Technologique. Specialists in different crops and social sciences are available within the different partner institutes

As well as very successful progress in understanding the basis of *in situ* conservation in Burkina Faso, the project has been instrumental in reviving the process for the establishment of a national programme. The *In Situ* project steering committee has played an important role in bringing the NPPGR to the attention of the Ministry of Higher Education. Inter-ministerial texts have consequently been prepared and will shortly be tabled to formalize the establishment of the institute under the umbrella of CNRST, after which a national plant genetic resources programme will be elaborated and adopted. The deliberate forging of intense inter-institutional and inter-disciplinary links, within the context of specific research projects that address different aspects of plant genetic resources conservation and use, may be a practical way to advance National Programme development in Burkina Faso and SSA as a whole.

A meeting with farmers on *in situ* conservation, Burkina Faso
K. Atta-Krah

Farmers' seed diversity fair in Mali.
A. Sidibe

In Mali and Zimbabwe, on-farm conservation activities are directed towards mitigating the effects of drought in marginal areas. Work is focusing on patterns of intra-specific crop diversity and how this diversity contributes to survival strategies. Another component focuses on developing community interventions to support the conservation and use of this diversity. The work involves many partners. In Zimbabwe, the Department of Research and Specialist Services provides national coordination, the University of Zimbabwe is involved in the molecular characterization and GIS aspects, and three NGOs carry out community activities. The Institute of Rural Economics (or Institut d'economie rurale—IER) provides national coordination and GIS experise, while IER and the Institute Polytechinique Rurale (IPR) carry out morphological and biochemical analysis. NGOs carry out community activities.

Through a combination of participatory surveys and morphological, biochemical and molecular characterization, the project aims to gain a better understanding of farmers' practices and their impact on diversity. The project has identified five main reasons why farmers maintain diversity: security in the face of unpredictable weather, particularly rainfall; optimum use of the resource base, particularly land with varying water availability; diversity of uses, particularly important where transaction costs are high; seed availability–farmers often plant the seeds they happen to have; and prestige–diversity is highly respected in some communities. Research is continuing to detail the above strategies and the role of specific diversity in their implementation.

The research has also revealed that, contrary to conventional wisdom, the flow of information on varieties and the flow of varieties themselves within a community is often much more limited than expected. The community activities in both countries are looking at seed diversity fairs as a mechanism for strengthening farmer exchange of information and specific varieties. These fairs have been extremely popular among farmers. Data have been gathered on seed exchanges for follow-up evaluation of the medium-term impact of these fairs on on-farm production.

The project is also attempting to develop 'farmer field fora' on plant genetic resources, a participatory activity aimed at providing a forum for exchange among farmers and researchers, in the hope that it would lead to improved collaboration and an improved understanding of diversity among farmers and researchers. In addition, the project is developing community genebanks in Zimbabwe.

In situ conservation in natural forest

In situ conservation of forest genetic resources allows the continuation of natural selection processes and the maintenance of the evolutionary or adaptive capacity of ecosystems. A central problem for sustainable development is striking a balance between uses of the resources and their conservation, such that satisfactory levels of development can be maintained. A variety of approaches are possible which combine strictly protected with multiple-use areas managed by local people or with natural forest managed for productive purposes, or with forest plantations intensively managed for production of wood or other products of importance to local communities. The SAFORGEN Programme conducts research activities in collaboration with Benin, Kenya and Togo on several important forest species (fodder, food and medicinal) to find different options for the conservation of these species.

Specific crops

IPGRI-SSA has focused on a number of specific crops of global and regional importance that contribute to food security, household income and national economies. In addition to the INIBAP research programme on *Musa*, crops under advanced research stages include wild rice, tubers and some Cucurbitaceae. IPGRI also has an explicit commitment to conservation and use of other specific crops of regional importance and its focus has been on leafy vegetables, coffee, cocoa, coconut, bambara groundnut and fonio.

Musa

Eastern and southern Africa

Conservation through utilization of bananas and plantains in the Great Lakes region

Bananas are a staple food crop in the Great Lakes region of eastern Africa and production is based on a set of unique cultivars known as the East African Highland Bananas. Within this cultivar group there is great diversity not found elsewhere. A project that aims to encourage *in situ* conservation of banana genetic resources through sustainable utilization was initiated in 1999 in the Great Lakes region with funds from IDRC. Researchers are working with farmers to identify the factors influencing farmers' decisions to conserve or discard diversity and to find ways of addressing the causes behind genetic erosion. Initial results of a survey of 145 households indicate that, although an average of 15 varieties are grown per household, 20–40% of the diversity that originally existed has been lost. Farmers have responded positively to the project, are holding stakeholder meetings and are enjoying new levels of communication.

Banana field, Bushenyi, Uganda.
INIBAP

Introducing banana varieties to Tanzanian fields

INIBAP is providing germplasm to a project in Tanzania, the KCDP, a Belgian–Tanzanian bilateral programme. Improved banana varieties were introduced into Kagera, a region which had been experiencing declining banana production during a critical period of population boom. By July 2001, over 70,000 plants will have been made available through tissue culture at the Katholieke Universiteit Leuven, Belgium. Collaboration with NGOs, schools, district extension services, the Ministry of Agriculture and farmers has allowed the KCDP to set up multiplication, demonstration fields and test plots.

The performance of FHIA-17, FHIA-23 and SH3436-9 and Pelipta has been impressive, generating high demand for planting material. The impact of the introduction of the new varieties is being monitored by the Agricultural Research Institute, Maruku and KCDP focusing on the number and yield of local and improved varieties in farmers' fields. The diffusion of new material indirectly into farmer's fields from demonstration fields and test plots is also being monitored. Preliminary results have found that yields from improved varieties in some places have exceeded existing varieties by a third.

Integrated pest management

Options for integrated pest managment are under evaluation as part of a farmer-participatory project in sites in Tanzania, Uganda and Kenya. Some of the techniques are new to the farmers and these will be introduced to participating NARS so that training can take place on a wide scale.

Musa biotechnology in Uganda

In 2000, the Government of Uganda approved the allocation of its CGIAR donation to INIBAP for the implementation of a *Musa* biotechnology project. A planning meeting was held in September 2000 involving all the project partners: NARO (Uganda), Makerere University (Uganda), CIRAD (France), the Katholieke Universiteit Leuven (Belgium), IITA (Nigeria and Uganda) and INIBAP. The project will focus on the introduction of genes for enhanced tolerance to pests and diseases into the traditional East African Highland Banana varieties. The project also involves a large component of capacity building, through training programmes and infrastructure development. This is a unique example of a developing country providing funding for biotechnology research on an important food crop.

West and central Africa

Integrated pest management of the banana weevil

An associate scientist seconded to CRBP has been managing a programme since 1999 to develop an integrated pest-management strategy against the banana weevil borer. Four species of weevil are present in smallholders' fields in southwest Cameroon: *Cosmopolites sordidus*, *Metamasius hemipterus*, *M. sericeus* and *Pollytus melleborgi*. Weevil larvae bore into the corm and weaken the plant, resulting in high plant mortality, reduced bunch weight and reduced hand number. The most severe infestations are caused by *C. sordidus*. Plantains appear to be most susceptible.

Different forms of pest control under trial in southwest Cameroon

Control	Agents/Methods
Biopesticides	Neem (*Azadirachta indica*), wood ash, coffee husk, hot pepper (*Capsicum* spp.) and *Tithonia* spp.
Trapping	Pheromone-baited traps
Biological control	Entomopathogenic fungi (*Beauveria bassiana*), entomopathogenic nematodes
Insecticides	Fipronil
In-built resistance	Varietal early screening method for resistance, field screening under high parasite pressure
Good husbandry	Use of clean planting material, hot water treatment or paring suckers, crop rotations

In the laboratory, young plantain suckers dipped in 20% neem solution have been found resistant to weevil attack for up to three months. Exposure to neem brings about a decrease in the fecundity of female weevils, rates of oviposition and hatching of eggs, resulting in a reduction in sucker mortality by 25–30%. However the toxicity of neem on adult weevils is low compared with other insecticides, which helps to explain why crushed neem seeds applied to the crown of the plant have no effect.

Wood ash, which is regularly used by 30% of households in Cameroon, has proved a moderate repellent but does not decrease oviposition, hatching or adult survival. Coffee husks had no effect whatsoever, but hot pepper blocked the hatching of eggs and had a moderate repellent effect on adults. A combination of neem and household ash, perhaps with a conventional insecticide or biological agent to control adults, may prove a useful combination.

The effectiveness of other forms of control, such as pathogenicity of entomopathogenic fungi and baited traps, on the population dynamics of the pest have also been examined. Several sources of resistance have been identified in banana varieties in rapid screening trials.

Rapid field multiplication of plantain

INIBAP is funding multiplication experiments in the University of Ghana Agricultural Research Station, which have provided a technique that could generate up to 1000 suckers from one Apantu plantain sucker in a single year, using just coconut water. By injecting 6–8 ml of coconut water (an average coconut fruit contains 150 ml of coconut water) into the base of a plantain sucker on three alternate days, apical meristem growth is slowed and radial growth is encouraged, resulting in the stimulation of axillary buds to form plantlets. The new suckers can be removed, and their corms split and sprouted in moist sawdust. So far the treatment has succeeded on three plantain varieties, Apem, Apantu and Asamienu. Work is continuing on other cultivars. If successful, the technique will provide a highly practical method of multiplication in the field that incurs very little expense.

Peri-urban agriculture

Through funding from the French Government, improved varieties of banana and plantain are being introduced into four cities in Benin and Ghana, in an attempt to boost the production of peri-urban agriculture. Sites for the multiplication of plantlets have been constructed and the participating farmers have been identified.

A Future Harvest programme for *Musa* in Africa

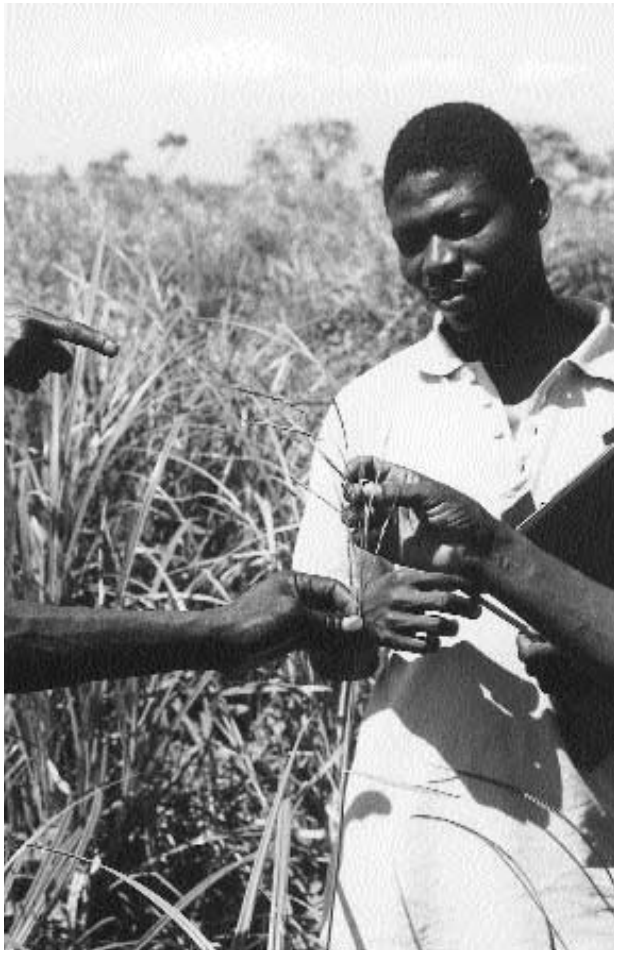
IPGRI (through its INIBAP programme) and IITA, the two Future Harvest centres with an interest in *Musa* research and development, have recently decided to integrate their *Musa*-related activities in Africa. The agreement to establish the joint programme was finalized in Uganda in September 2000. The two organizations believe that it would be more beneficial for all stakeholders if their complementary programmes are combined into a single, well-focused research effort under the framework of the two subregional banana research networks, BARNESA and *MUSA*CO. The main elements of the collaboration involve strategic planning, germplasm conservation and evaluation, information management and public awareness. As the first indications of the newly formed partnership, the *Mus*Africa newsletter, previously published by IITA, will come out as a joint IITA–INIBAP publication and both organizations will report the highlights of each other's annual activities in their respective annual reports.

Wild rice

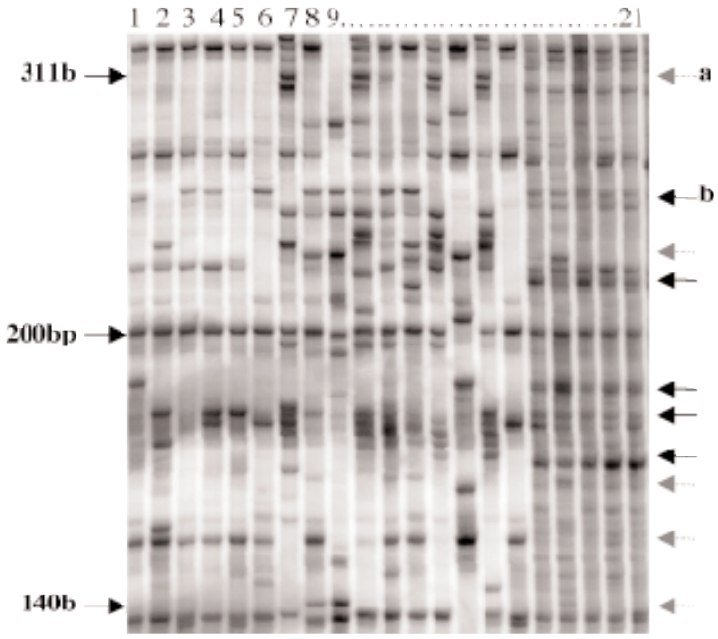
Ecogeographic distribution and molecular diversity studies in East and southern Africa

IPGRI in collaboration with the SADC Plant Genetic Resources Centre, IRRI and national programmes has started a collection and conservation programme for wild rice species in East and southern Africa. The region is home to five wild rice species: *Oryza barthii*, *O. punctata*, *O. eichingeri*, *O. longistaminata* and *O. brachyantha*. The rationale of the study was that the diversity of wild rice species is not well represented in base collections and there are significant gaps in the knowledge of the diversity of these species in the region. The diversity of this genepool is also threatened in the region due to drainage of wetlands and other forms of destruction of wild rice habitats. A preliminary ecogeographical survey was carried out jointly with the national programmes followed by 17 collecting missions in which 326 accessions of wild rice and related genera were collected and conserved both in national programmes' genebanks and in IRRI.

A more in-depth scientific study on the ecogeographical distribution and molecular diversity of the wild rice species was then carried out. In this study a combination of different GIS software and data sets were used to determine the ecogeographical distribution. The ecogeographic distribution of the five species was defined using digitized maps developed from geo-referenced passport data, in combination with different GIS tools such as Archview, FloraMap and GRID. New areas of species range of distribution for *O. barthii*, *O. punctata* and *O. eichingeri* emerged. The potential distribution maps for all five species were created using FloraMap. Using the Spatial Intra-specific, Diversity GIS software, diversity hotspots were located in Tanzania, Uganda, Malawi and Kenya.

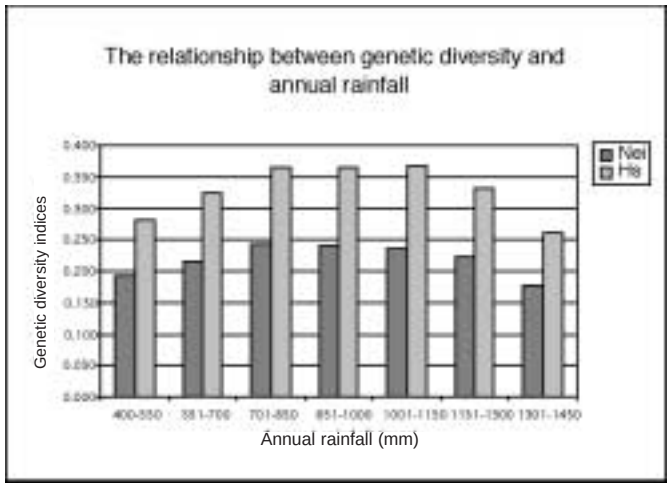


Collecting wild rice near the Tana River, Kenya. GIS tools and geo-referenced passport data from genebanks have been used to determine the ecogeographic distribution of wild rice species. The results help target collecting efforts in areas that are under-represented in genebank collections.
D. Kiambi



Molecular marker diagram showing diversity of *Oryza longistaminata*. AFLP amplification products generated using primer combination E1+M2 reveal: (a) polymorphism in populations from different countries and (b) markers discriminating the Namibia populations with very low level of polymorphism. Lanes 1–12 contain Tanzania populations, Lanes 13–16 are Zimbabwe populations and Lanes 17–21 contain Namibia populations, which are clearly distinct.

Environmental data in GRID, FloraMap, world climate and vegetation maps from UNSO and Whits World Vegetation Map (Africa chapter and Flora of Zambeziaca) were used to assess the relationship between environmental and ecogeographical variables on both inter- and intra-specific diversity. The abundance of *Oryza barthii*, *O. brachyantha* and *O. punctata* was closely associated with altitude but the species had different 'optimum ranges'. Using ecogeographical and molecular diversity data, the study developed priorities for both *ex situ* and *in situ* conservation of wild rice in East and southern Africa. In particular, a 'curvilinear' relationship between genetic diversity and rainfall was observed.



The mapping of molecular markers and species diversity (using Nei and Hs genetic diversity indicators) revealed that their distribution follows environmental and geographical gradients, consistent with documented ecological principles.

Tubers

Tuber crops provide an important source of food in most humid and subhumid tropical countries of SSA. All are clonally propagated and therefore slow to multiply and difficult to conserve. IPGRI is working to establish an integrated strategy to conserve and use tuber crops by combining different *ex situ* and *in situ* approaches to the problem. Yam (*Dioscorea* spp.), cocoyam (*Xanthosoma sagittifolium*) and frafra or Hausa potato

(*Plectranthus rotondifolius*) have been selected as model crops for this work. Cultivated yams constitute a multi-species crop, including the traditional varieties of the *D. rotundata-cayenensis* complex, of *D. bulbifera* and *D. dorietorum* as well as introduced species such as *D. alata* and *D. esculenta*. Approximately 93% of the world's yams are produced in the 'yam belt' of West and central Africa. A considerable amount of the crop is cultivated by small- to medium-scale farmers and a large part of the community depends on it for food security and generation of income. Cocoyam is the third most important root and tuber crop in West and central Africa and probably the most important leafy vegetable. Frafra or Hausa potato, once an important crop in SSA, which has been almost totally neglected by research, has seen a significant decrease in its cultivation and use over recent years, although its area of distribution is still wide.

Tuber crop diversity in Nigeria.
IPGRI

Work began with the study of the distribution of diversity and of farmer practices for the management of tuber diversity. A survey of ethnobotanical practices of cocoyam cultivation looked at farmers' knowledge and description of genetic diversity, morphogenesis, reproduction of the crop and agronomic practices; the level of on-farm conservation of the germplasm; and uses to which farmers put the crop. RAPD markers were used to characterize collected germplasm. The activities were carried out in collaboration with the Botany Department, University of Ghana and the Plant Genetic Resources Centre of Ghana, University of Cocody in Côte d'Ivoire and the National Centre for Genetic Resource and Biotechnology in Nigeria.

IPGRI and two Ghanaian plant genetic resources institutions, the Savannah Agricultural Research Institute and the NPGRC, carried out a survey of frafra potato conservation practices among farmers in northern Ghana. The study found differences in whether farmers used seed tubers or stem cuttings as planting material and recorded storage techniques and cultivation practices. The farmers' classification system and emphasis on different traits depended on which propagation system they used. Germplasm was collected and is being characterized at the Plant Genetic Resources Centre at Bunso, Ghana.

A joint IPGRI–IITA project is studying farmers' practice of yam domestication and its contribution to improvement of the crop in West Africa in collaboration with Bariba, Nago and Fon farmers, Université National du Benin with IRD, Institut National des Recherches Agricoles du Benin, and the CIRAD-IITA Yam Research Coordination Unit. The current diversity in the traditional yam landraces, principally *D. rotundata-cayenensis*, is attributed to the availability of wild yams with cropping potential, different selection pressures, successive domestication, culture-derived modifications and somatic mutations. Wild species believed to have produced cultivated forms in West Africa include *D. burkilliana*, *D. abyssinica* and *D. praehensilis*. This process takes the wild species *D. abyssinica* and *D. praehensilis* through a farmer-developed technique of clonal propagation that transforms

the material physiologically to produce cultivated varieties similar to members of the *D. rotundata-cayenensis* complex. The activity aims to move towards a process of farmer-led participatory plant breeding.

Field collections are the most common method of conserving tuber crops. This is a very expensive and labour-intensive approach, generally requiring annual regeneration. The collections are also very vulnerable to pests and diseases, made worse by the clonal nature of propagation of these crops and the diverse origins of the material. They are, in effect, often also collections of diseases as diverse as the collection itself and can be a potential source of further contamination as material is distributed. *In vitro* cultivation is one approach that can be used both for cleaning planting material and keeping it in a state free from contamination. IPGRI and the University of Ghana are testing procedures for *in vitro* slow growth conservation for yam and developing new methods for cocoyam and frafra potato. The ultimate goal is cryopreservation in liquid nitrogen at –196°C, which will allow effectively indefinite storage. Dehydration and encapsulation protocols for yam cryopreservation developed by IRD are being tested at the university and new methods are being developed for cocoyam and frafra potato.

Cucurbitaceae

The Cucurbitaceae is a large family which includes many economic species such as melon, watermelons, various gourds and pumpkins that are of particular importance for the inhabitants of SSA. Many Cucurbitaceae species are eaten in several different forms, as seeds, leaves, fruits and sometimes flowers, by villagers throughout Africa. IPGRI, with national and international partners, has been leading the work on collecting, characterizing and conserving diversity, as well as on ethnobotany, of Cucurbitaceae in the region.

West Africa

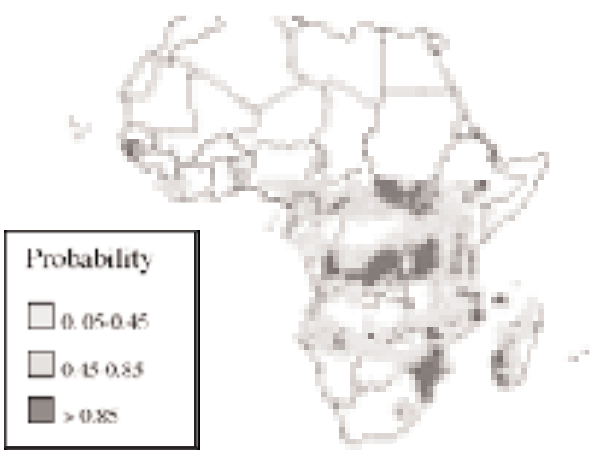
In West Africa work has focused on collecting and characterizing egusi crops. Egusi is the local name given in Benin, Togo, Ghana and Nigeria to the seeds of various Cucurbitaceae species. Egusi crops provide essential grain for the diet of the people inhabiting the southern coast of West Africa. The research activity, jointly conducted by the National Agricultural Institute of Benin, the Faculty of Sciences and Technology of the University of Benin and IPGRI, aims to study cultural practices, genetic diversity, use and marketing of the egusi crops *Citrullus* spp., *Cucumeropsis* spp., *Lagenaria siceraria* and *Telfairia occidentalis* in Benin. Seeds, fruits and indigenous knowledge have been collected from farmers from different regions. The different varieties were evaluated at Sekou research station in Benin. A total of 63 accessions belonging to *Citrullus lanatus*, *Lagenaria* spp., *Cucumeropsis edulis* and *Telfairia occidentalis* were screened and first results showed a wide range of variation among and within *Lagenaria* varieties, especially in the useful traits of fruit shape, colour and size. This wider knowledge of these little-studied crops is being used in developing new varieties that will increase production levels in the region.

Egusi crops attract many insect pests, some of which are specific to a few genera. Collaboration with IITA's Insect Museum identified eight main insect species belonging to five families in Benin. Five species are specific to *Lagenaria*, two are common to *Lagenaria* and *Citrullus* and one, *Apis mellifica,* is present mainly on *Cucumeropsi edulis*. In order to

develop an integrated programme of economical pest management, however, further fundamental information about the crops is required. For instance, *Lageneria* demonstrated very good ability to suppress weeds and to provide more organic matter to the soil than *Citrullus*, which has a shorter growth cycle and less leaf area, and similar studies in Nigeria showed the geographical distribution and importance of *Citrullus lanatus* and *Cucumeropsis manii* in that zone. These data can be used in determining methods to decrease overall crop production costs.

East and southern Africa

IPGRI-SSA staff made an extensive literature review and a study on the origin of the species *Cucumis melo* (melon). The work revealed that the sweet wild melon found today is probably a result of domestication and cultivation as hybridization of melon occurs frequently in nature. FloraMap, a GIS tool developed by CIAT, has been used to determine the ecogeographic distribution and genetic diversity of *C. melo* and relatives in SSA. Work on developing a descriptor list has been started as well as on a monograph in the underutilized crop series. In the near future, the collection, characterization and molecular work on *C. melo* and wild relatives in the SSA will be the subject of a PhD research study.



Probability density distribution map of *Cucumis melo* in Africa South of the Sahel.

A new technique for documentation of indigenous knowledge on *Lagenaria* spp. is also being developed as part of a PhD study with the Tokyo University of Agriculture and in collaboration with the National Museum of Kenya, the Kenya Society for Ethno-Ecology and the Gene Bank of Kenya. The project focuses on symbiotic relationships between people and domesticated plants and gives a practical example of the interdependence of culture and biodiversity. The study illustrates the diversity of gourd uses among Kenyan communities, cultivation of the gourd and the effect of modernization on genetic diversity and gourd-related customs.

Leafy vegetables

Leafy vegetables are important in the diet of many Africans. An IPGRI project on traditional African leafy vegetables is yielding important insights into the diversity, uses and farmer management of germplasm that is challenging conventional beliefs about these underutilized species. Development specialists did not think that leafy vegetables were cultivated very widely, but rather that they were gathered from the wild. Socioeconomic research sponsored by IPGRI found the reverse. Farmers actively cultivated leafy vegetables and managed them according to the diversity they knew was within the species. For example, bitter leaf (*Vernonia amygdalina*) has several distinct genotypes with different degrees of bitterness that different cultural groups prefer. Farmers would select the material they planted depending on who would be buying and eating the leaves.

The black nightshades (*Solanum nigrum* complex) are used widely as leafy vegetables and as a source of fruit and medicinal herbs, particularly in the West African forest zones. While *S. nigrum* grows easily and spontaneously in the forest, the seeds for the preferred types are eagerly sought after in markets and so form a good source of income for the forest farmers. However, the farmers need to be sure they can supply seeds that produce plants

that meet consumer tastes, require little preparation and produce most yield. IPGRI project research documented for the first time the value of these leafy vegetables in maximizing the productivity of small plots of land in the forest. The work also highlighted how important it is to maintain the genetic base of the crops and the stability of the ecosystem within the forest farming system to protect the livelihood of low-income farmers in West Africa.

Workshop trainees harvesting eru in Cameroon.
N. Ndam

Other crops

IPGRI has recently started projects on several other crops of importance in the region, including coffee, cocoa, coconut, bambara groundnut and fonio.

Coffee is a commodity of enormous value to many SSA countries, but its production in the region has not evolved compared with Latin America. Consequently, Africa has been losing its competitive edge. Yet Africa is the cradle of coffee diversity and offers great opportunities for the improvement of the crop. Some of this diversity has already been collected during past FAO, IBPGR and ORSTOM collecting missions. Some countries, such as Ethiopia, have also been collecting coffee germplasm and conserving it in field genebanks. These collections are not very secure, however, as field genebanks are expensive to maintain and many of the plants succumb to disease, pests and natural catastrophes. Further, as they have not been fully characterized and evaluated, much of the collections are not used by breeders. Some work on finding alternative methods of conserving coffee germplasm is being undertaken by the IRD and IPGRI. Seed desiccation studies have been initiated to determine the storage behaviour of some wild species. IPGRI is currently in the process of developing a project on "Enhancing the use of coffee germplasm" in partnership with the ACRN and the ICO as well as a number of coffee producing countries in the SSA region.

Coffee Field Bank at CATIE, Turrialba, Costa Rica.
M.E. Dulloo

The West African countries of Cote d'Ivoire, Ghana, Nigeria and Cameroon are participating in the globally coordinated project on cocoa germplasm utilization and conservation. Another global initiative led by IPGRI, the International Coconut Genetic Resources Network (COGENT), has encouraged participation of several countries in the SSA region, particularly in the tropical coastal areas, to work towards improving coconut production and efficient utilization of its products.

The bambara groundnut, an important hardy African pulse legume, is the subject of a number of research initiatives aimed at gaining a better knowledge of the biology, ethnobotany and management of the crop.

Fonio (*Digitaria exilis*) is a drought tolerant grain, often consumed in West Africa during the hunger season, when the majority of crops are too immature to provide food. Very little research has been undertaken on this crop. As a first step towards understanding fonio better, a monograph is being developed.

Building training capacity in SSA

Training is fundamental to IPGRI's work to establish viable national programmes in client countries. The GPA highlighted training and capacity building as a priority action, as almost 80% of the country reports referred to lack of training as a serious constraint in their national programmes.

Graduate-level training

In 1993 IPGRI and regional partners decided that the most efficient approach for training in the SSA region would be to work in three subregions: southern Africa, eastern Africa and West and central Africa. Focal institutions were identified for each of the subregions: the Department of Crop Science at the University of Zambia, the Crop Science Department at the University of Nairobi, Kenya and UCA, Côte d'Ivoire. IPGRI assisted by making links with overseas universities and other institutions of excellence which enabled study tours, specialized training courses, sharing of resource persons, interaction of staff from different institutions and provision of key training and reference materials.

Between 1993 and 1996, staff at the University of Zambia received substantial assistance through fellowships, sabbaticals, staff attachments and hands-on training. By 1996 the university had formally incorporated an elective plant genetic resources option into its MSc Agronomy programme. The first three students obtained fellowships from IPGRI (using funds from UNEP) to enrol during the 1999–2000 academic year and early results are overwhelmingly positive. The students have begun research on thesis projects that are directly relevant to genetic resources work in the country. The lecture programme is proving highly effective, with participation by the staff of IPGRI and the NPGRC of Zambia.

At the University of Nairobi, there are a number of relevant degree programmes on plant genetic resources for both undergraduate and postgraduate students. These are offered in the Department of Crop Science, Department of Range Management, and the Institute of Dryland Research, Development and Utilization (IDRDU). The Department of Crop Science, which offers the widest range of both plant and crop sciences, currently has three postgraduate degree programmes that can incorporate a genetic resources component. These are MSc Agronomy, MSc Horticulture, and MSc Plant Breeding including a biometry unit.

In West and central Africa, the first university to develop specialized plant genetics training at MSc level was the UCA. Studies in the field of plant genetic resources started in the early 1980s at the UCA through collecting and characterization of wild and cultivated yams, mainly supported by IBPGR and later on by IPGRI. Teaching of plant genetic resources started in 1989 as an important component of the MSc in Plant Breeding and Biotechnology. The MSc programme was restructured in 1998 to give an MSc Genetics course with four distinct options: plant breeding, plant genetic resources, animal breeding and genetic resources, and genetics in medicine. Plant genetic resources was then recognized as a full option and institutionalized in the formal curriculum. Since 1989, students from Benin, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Niger and the Republic of Central Africa have been trained at UCA. Most of them are currently playing very active roles in research and training in their respective national programmes.

IPGRI organized in-country (1996) and regional training courses (Darwin Initiative on *ex situ* conservation techniques in 1998) jointly with the staff of UCA. A professor of UCA has since joined IPGRI-SSA training staff as an Honorary Fellow and is actively working on strengthening the capacities of the university to deliver high-quality training. IPGRI-SSA has also started the process of identifying a second focal university among the anglophone countries to reinforce the training capacity in the subregion.

Region-based training

Language issues in West and central Africa

The GPA recommended that training courses should be developed and offered in close collaboration with regional networks and national programmes. Francophone countries are spread across most of the West and central African zone. IPGRI has undertaken various training initiatives in the area, by providing training for national programme staff and organizing regional group training courses. However, the staff of the national programmes and regional institutions in these countries continue to face language barriers in the areas of training opportunities, access to scientific information, training materials and information exchange. The development of national programmes in the francophone countries in SSA still lags behind most other countries in the region. From early 1999, IPGRI in collaboration with the francophone countries started a joint effort to solve these common problems. A training project called the Francophone Initiative is being developed to support plant genetic resources training in the French-speaking countries of the subregion. As part of this effort, an informal group of collaborators is working with IPGRI to facilitate networking among universities in the subregion and to help translate the most relevant scientific literature and training modules into French. In 2000 for example, four IPGRI training modules were translated from English into French by a consultant from the UCA.

Language issues in Portuguese-speaking countries

The implementation of the plant genetic resources action plan of the Lusophone Countries of Africa under the umbrella of the Lusophone Initiative has provided a platform for responding to specific training needs for the five Portuguese speaking countries in Africa: Angola, Cape Verde, Guinea Bissau, Mozambique, and São Tomé and Principe. Individually tailored training has been implemented for staff from all the countries in collaboration with INIA, Portugal and Centro Nacional de Recursos Genéticos, Brazil as major partners. In-country training was implemented in Angola, while a regional training course was also hosted by the Angola National Plant Genetic Resources Programme. All these programmes are conducted in Portuguese, using Portuguese-language materials, and have improved the abilities of local staff to participate in regional work on genetic resources.

Complementary institutional strengths in East Africa

In late 1999 IPGRI organized a meeting with representatives from five universities and three national programmes in eastern Africa to discuss subregional approaches to training. The meeting considered current global tends, analysed potential institutional contributions and identified mechanisms to link national and regional training needs. This landmark meeting established the Eastern Africa Plant Genetic Resources Training Consortium, which will coordinate all training activities on genetic resources in the subregion. The development was also a positive response to the challenges of the GPA to countries and regions to take a more active position in the conservation and use of their own plant genetic resources.

The group is working to ensure that genetic resources training remains a national priority in order to secure national funding. Its potential linkages with EAPGREN will also enable it to link training activities to plant genetic resources projects within the region. Each member of the consortium will play a role according to its strengths. The universities will take the lead in actual training, based on the topics they offer at undergraduate and postgraduate level; the national programmes will identify areas of practical importance and provide research facilities for the students.

Documentation and information support

Skills to handle data and the tools to access this and other information, are key issues in SSA. IPGRI's national programme partners recognize that germplasm documentation and access to information are critical for plant genetic resources conservation and use. Regional staff make particular efforts to ensure that efficient documentation systems are adopted, and that the skills to use them are developed. To stimulate plant genetic resources work in the region, IPGRI actively promotes such new technologies as GIS and data quality issues to enhance documentation and analytic procedures at genebanks and *in situ* conservation sites.

Good management of plant genetic resources is invariably founded on good science and policies. IPGRI as an institution is fully cognizant of this, and produces and makes available a large array of research and policy material and publications that are widely distributed to scientists in the region.

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Acronyms

ACRN	African Coffee Research Network
ACTS	African Centre for Technology Studies, Kenya
AfDB	African Development Bank
AFLP	Amplified fragment length polymorphism
ASARECA	Association for Strengthening Agricultural Research in East and Central Africa
BARNESA	Banana Research Network for East and Southern Africa
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Centre for Tropical Agriculture, Columbia
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement, France
CNRST	Centre Nationale de la Recherche Scientifique et Technologique
CNSF	Centre National de Semences Forestières, Burkina Faso
COGENT	International Coconut Genetic Resources Network
CORAF	Conference of Directors of Agronomic Research in West and Central Africa
CRBP	Centre Régionale de Recherches sur Bananiers et Plantains
DFSC	Danida Forest Seed Centre
DSE	Deutsche Stiftung für internationale Entwicklung
EAPGREN	Eastern African Plant Genetic Resources Network
FAO	Food and Agriculture Organization of the United Nations, Italy
FDS	Fondation pour le Développement du Sahel
GIS	Geographic information system
GPA	Global Plan of Action
GRENEWECA	Genetic Resources Network for West and Central Africa
GRID	Global Resources Information Database
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit, Germany
IBPGR	International Board for Plant Genetic Resources (now IPGRI)
ICIPE	International Centre of Insect Physiology and Ecology, Kenya
ICO	International Coffee Organisation
IDRC	International Development Research Centre, Canada
IDRDU	Institute of Dryland Research, Develpment and Utilization
IITA	International Institute of Tropical Agriculture, Nigeria
INIA	Instituto Nacional de Investigaçáo Agraria, Portugal
INIBAP	International Network for the Improvement of Banana and Plantain
IPGRI	International Plant Genetic Resources Institute, Italy
IRD	Institut de Recherche et Développement, France
IRRI	International Rice Research Institute, Phillippines
IUCN	The World Conservation Union
KCDP	Kagera Community Development Programme
KEFRI	Kenya Forestry Research Institute
*MUSA*CO	Banana Network for West and Central Africa
NARI	National Agricultural Research Institute
NARO	National Agricultural Research Organization, Uganda
NARS	National agricultural research system
NGB	Nordic Gene Bank, Sweden
NGO	Non-governmental organization
NPGRC	National Plant Genetic Resources Centre
NPPGR	National Programme for Plant Genetic Resources
NTSP	National Tree Seed Programme, Tanzania
ORSTOM	Organisation de Recherche Scientifique et Technique Outre Mers (now IRD)
PRO*MUSA*	Global programme for *Musa* improvement
RAPD	Randomly amplified polymorphic DNA
SACCAR	Southern Africa Centre for Cooperation in Agricultural Research
SADC	Southern African Development Community
SAFORGEN	Sub-Saharan Africa Forest Genetic Resources Network
SIDA	Swedish International Development Agency
SPGRC	SADC Regional Plant Genetic Resources Centre
SSA	Sub-Saharan Africa
UCA	University of Cocody in Abidjan
UNEP	United Nations Environment Programme
UNSO	United Nations Sudano-Sahelian Office
WECARD	West and Central African Council for Agricultural Research and Development
ZEL	Zentralstelle für Ernährung und Landwirtschaft

IPGRI in sub-Saharan Africa

SSA 1999–2000

Regional Report

ISBN 92-9043-490-2